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Fuel Cells in Transportation: What Should We Expect in 2003?

If you thought 2002 was a big year for fuel cells in transportation applications, take a look at what's coming in 2003.

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The California Fuel Cell Partnership headquarters facility, with fuel cell vehicles. Left to Right: Ford P2000, Honda FCX-V4, GM HydroGen3, DaimlerChrysler NECAR4a, VW HY Motion, Nissan Xterra FCV, Toyota FCHV-4, and Hyundai FCEV.

Fuel Cell Vehicles in 2003

Every major automotive manufacturer has supported fuel cell vehicle (FCV) development in recent years. On December 2nd 2002, an historic event occurred. The first hydrogen FCVs were delivered to customers for lease in Japan and the United States. Toyota Motor Corporation and Honda Motor Co., Ltd. delivered leased vehicles to the Japanese government and to entities in California. These deliveries will be followed by the introduction of many more fuel cell passenger vehicles and buses that are expected to hit the road in 2003.

Toyota delivered its first two hydrogen FCVs to the University of California, Irvine (UCI) and the University of California, Davis (UCD) in December, 2002, under a 30-month lease and research agreement. Four additional vehicles will be delivered to UCI and UCD in early 2003. The Toyota fuel cell hybrid vehicle (FCHV) is based on the Toyota Highlander five-passenger mid-size sport utility vehicle (SUV). The FCHV has a top speed of 96 mph and an EPA-certified cruising range of 180 miles.

Toyota has provided more than \$2 million to the University of California for research in advanced transportation systems including FCVs since 1997. Research grants to support vehicle use and additional transportation studies at UCI and UCD will more-than-double over the next 3-1/2 years. This research includes a plan to establish fully functional, fuel-cell-friendly model-communities in northern and southern California and developing and expanding hydrogen-refueling infrastructure in these communities.

The City of Los Angeles took delivery of a Honda FCX in December, 2002 under a two-year lease agreement. Four additional vehicles will be delivered to the (cont. pg. 2)

What's in Store for the California Fuel Cell Partnership

The race to commercialize fuel cells for transportation is a marathon, but the race is on, paced by the efforts of the California Fuel Cell Partnership (CaFCP), a public-private consortium of auto manufacturers, energy providers, fuel cell companies, and government agencies – all working together voluntarily to raise awareness of fuel cell vehicles (FCVs) and their commercialization challenges.

CaFCP made great strides in 2002, delivering on its commitment to take on the challenges of real-world FCV testing and demonstration of fuel alternatives. Twenty FCVs have now been activated into the project; there are now four fueling stations (three delivering direct hydrogen, one providing methanol) for the project's vehicles.

The measurable results of 2002's activities help place into context where CaFCP will travel next. Those activities were highlighted by public outreach events conducted to increase public awareness and acceptance – primary stepping stones to successful commercialization.

Over the past year, CaFCP directly acquainted more than 200,000 people with FCVs — more than 5,000 of those were able to actually drive in one. Other achievements included:

♦ initial FCV placement into fleets by several automakers;

(cont. pg. 2)



Toyota unveiled its FINE-S fuel cell concept at the North American International Auto Show.

Other News of Note

Toyota unveiled the FINE-S hydrogen fuel cell hybrid-electric concept vehicle at the North American International Auto Show (NAIAS). The FINE-S is reminiscent of the General Motors (GM) HyWire vehicle (see photo above), in that it features a revolutionary shared platform that provides the ability to modularly install fuel cell components throughout the vehicle.

General Motors and the U.S. Army revealed a diesel hybrid military pickup truck equipped with a fuel cell auxiliary power unit (APU) that could become the model for the Army's new fleet of 30,000 light tactical vehicles by the end of the decade.

The 5-kW PEM fuel cell APU is designed and built by Hydrogenics to be a regenerative fuel cell system capable of producing both electricity and hydrogen in remote areas.

The hybrid improves fuel consumption by 20 percent over conventional diesels, which is important as current fuel transportation costs reach up to \$400 a gallon depending on training or battlefield operations.

Larry Burns, GM VP of research and development and planning, said "The energy density of hydrogen and the efficiency of the fuel cell gives the same capacity of equal-sized batteries but with six to 10 times longer operation, particularly in adverse temperature conditions."

GM will deliver the diesel hybrid truck to the Army later in 2003 as part of the Commercially Based Tactical Truck (COMBATT) program.

BERNADETTE GEYER, EDITOR

(Fuel Cell Vehicles, cont. from pg. 1)

City in 2003. The Honda FCX is the only FCV certified by the California Air Resources Board (CARB) and U.S. EPA for commercial use as a Zero Emission Vehicle (ZEV). The FCX has an EPA certified range of 170 miles and seating for four people. Honda plans to lease about 30 fuel cell cars in California and Japan during the next two to three years.

DaimlerChrysler has two FCVs under development, the Jeep Commander 2 and the NECAR 5, which is based on the Mercedes A-Class car that seats five passengers. Unlike many of the other manufacturers, the NECAR 5 is methanol-fueled, with hydrogen generated by methanol reformation. DaimlerChrysler intends to provide 15 FCVs to the California Fuel Cell Partnership before the end of 2003.

In mid-December 2002, General Motors Corp. and FedEx Corp. announced they will launch a joint project in Tokyo in June 2003 using fuel-cell powered package delivery vehicles. The project will be conducted on a test-basis for one year. *USA Today* later reported that General Motors downgraded development plans for fuel cell technology, but aims to sell 1 million gasoline/electric hybrid vehicles by mid-decade.

In early December, Nissan Motor Co. gained Japanese government approval to test-drive its fuel cell-powered X-Trail SUV on public roads. Nissan plans to start leasing FCVs in 2003, two years ahead of its original plan. Nissan noted that it had purchased a fuel cell developed by UTC Fuel Cells.

All-in-all, 2002 and 2003 are poised for historic recognition as monumental to the introduction of fuel cell powered transportation applications.

JACOB BROUWER, PH.D., KIM BERGLAND
NATIONAL FUEL CELL RESEARCH CENTER

(CaFCP, cont. from pg. 1)

- ♦ a 300-mile road rally along California's Central Coast;
- ♦ expansion of fueling facilities with installation of another hydrogen station and a methanol fueling station;
- ♦ began a new study to examine the issues for housing and servicing FCVs;
- ♦ training of several emergency response agencies;
- ♦ led a summit meeting of fuel cell organizations from around the world; and
- ♦ distribution of more than 1,000 fuel cell learning kits to middle and high school teachers.

2003 promises continued progress for FCVs and fuels. CaFCP expects to see the number of FCVs on California's roads triple to 60 by 2004, while building additional hydrogen fueling stations to accommodate them. These targets help support the next phase: real-world, real-person fleet vehicle and fueling demonstrations. To further this development, CaFCP will concentrate its efforts on these tasks:

- ♦ promote fueling station interoperability (i.e., common fit, use and access among vehicles);
- ♦ develop and implement a First Responder training program targeting vehicle and fueling demonstration communities;
- ♦ expand outreach and education efforts to increase public awareness;
- ♦ coordinate activities with other FCV projects worldwide, especially to promote consistent data collection and evaluation for bus demonstration programs (primarily in conjunction with the European Fuel Cell Bus Project);
- ♦ continue to work closely with the environmental community to promote common goals.

Looking beyond 2003, CaFCP members expect to continue tapping into the synergy that comes from their joint activity, led by the placement of vehicles into the hands of real-world users, continued demonstration of fuel alternatives, and continued emphasis on public outreach. To this end, look for a formal announcement of CaFCP's plans in April.

As the 2003 CaFCP Chairman, Alan Lloyd, who also chairs the California Air Resources Board, says, "We are harnessing the energy, know-how and passion among our members to build bridges that reach into the future – steps that deliver sustainable mobility for the next generation. It's an exciting time for fuel cells!"

JOE IRVIN, COMMUNICATIONS MANAGER
CALIFORNIA FUEL CELL PARTNERSHIP

Fuel Cell Bus Projects: What to Expect in 2003

Several fuel cell buses are operating in California, Europe and Japan. Over the next few years, the number will increase dramatically.

Projects in the U.S. and Canada

The *California Fuel Cell Partnership (CaFCP)* expects to place six to seven fuel cell buses at various transit agencies: SunLine Transit, AC Transit, and Santa Clara Valley Transportation Authority (VTA), beginning in 2004. Since October 2002, SunLine has been testing a 30-ft. fuel cell bus built by ThunderPower LLC, a joint project of ISE Research, Thor Industries and UTC Fuel Cells and will also demonstrate a 45-ft. NABI fuel cell bus for the CaFCP program in 2004. AC Transit will demonstrate three 40-ft. Van Hool Buses for this program and Gillig Corporation is building three fuel cell buses for VTA's CaFCP program involvement.

The *Advanced Vehicle Development Program at Georgetown University* pioneered fuel cell bus demonstrations in 1983 when they and the Los Alamos National Laboratory conducted feasibility studies. Financed by the U.S. Department of Energy and the Federal Transit Authority (FTA), Georgetown is working on assembling the first Generation III bus, scheduled for introduction in 2003. A previously-demonstrated Generation II bus will be demonstrated by Washington DC's public transit system (WMATA) for one year starting in mid-2003.

Electric Fuel Transportation Corp. (EFC), a leading manufacturer of zinc/air fuel cells for buses, plans to introduce 2 to 5 buses to Regional Transportation Commission of Southern Nevada (RTC). In May 2002, RTC agreed to operate a mini-fleet of Electric Fuel Corp.'s zinc/air fuel cell buses.

Northeast Advanced Vehicle Consortium (NAVC) in Boston is working with UTC Fuel Cells on a project funded by the Department of Transportation (DOT) to design a heavy-duty, zero-emission, ambient-pressure fuel cell power plant for buses.

Natural Resources Canada (NRCan) is working to integrate Hydrogenics Corporation's power module technology into a 40-ft. New Flyer Industries bus for operation in March 2005. This project will use Hydrogenics' proprietary vehicle-to-grid technology, which will enable the vehicle's power supply to provide off-board power and power to the electrical grid, while the vehicle is sitting idle.



Top: the Citaro fuel cell bus; Bottom: SunLine/ThunderPower bus.

International Projects

DaimlerChrysler is building 33 Citaro fuel cell buses for the CUTE, ECTOS, and STEP programs. The CUTE, or Clean Urban Transport for Europe, program involves the demonstration of 27 Citaro fuel cell buses in nine European cities. Two years of everyday commercial use and operation will start in 2003 in The Netherlands, Spain, Germany, Great Britain, Luxembourg, Portugal, and Sweden. Each country has set up its own fuel cycle and study focus, convenient to their own infrastructure and abilities. The ECTOS program (Ecological City Transport System) in Reykjavik, Iceland, will have three Citaro buses used in a four-year project, starting in 2003. Also, the STEP program in Perth, Australia, will have three Citaro fuel cell buses driven on public transport routes from 2004 to 2006.

The *Global Environment Facility (GEF)* and *United Nations Development Program (UNDP)* are supporting commercial demonstrations of fuel cell buses and associated refueling systems in Beijing, Cairo, Mexico City, New Delhi, Sao Paulo, and Shanghai. The long-term strategic vision for this support is to help reduce Greenhouse Gas (GHG) emissions from the transportation sector in GEF countries. The program involves information and cost-sharing between UNDP, GEF, private industry, and local/national governments. This program is in the beginning of the demonstration phase, the second of three phases, and is focusing on the operational viability of fuel cell buses for urban transit in the targeted major cities. The fuel cell bus demonstration fleets in the five countries are expected to begin actual operation in 2003 and early 2004. In Phase 3, GEF will support each city's commercialization efforts.

Toyota and Hino Motors have built two fuel cell hybrid buses, FCHV-BUS1 and BUS2. Toyota claims these vehicles are three-times more efficient than conventional gasoline-powered vehicles. The FCHV-BUS2, released in 2002, has received Japanese Transport Ministry approval for public road testing, which will continue into 2003. The Tokyo metropolitan government will use Toyota and Hino Motors fuel cell buses during the summer of 2003 on Tokyo's new waterfront route. This will mark the national debut of fuel cell buses used in Japan's public transit service. (cont. pg. 4)

8th Grove Fuel Cell Symposium

Join international delegates to discuss developments in fuel cell technology and commercialisation at the Eighth Grove Fuel Cell Symposium, 'Building Fuel Cell Industries,' 24-26 September 2003, London, United Kingdom.

A comprehensive conference programme will cover developments in all types of fuel cells, progress in stationary and mobile applications and the infrastructure which is emerging.

A large exhibition area - new for 2003 - will include fuel cell and component manufacturers and feature a dedicated Fuel Cell Demonstration Area.

To keep pace with developments, sign up for the Grove Fuel Cell Email List at www.grovetfuelcell.com or contact sm.wilkinson@elsevier.com.

Calendar

8th Grove Fuel Cell Symposium

ExCeL, London, UK - 24-26 September 2003.

Visit <http://www.grovetfuelcell.com/> for information.

NHA's 14th Annual U.S. Hydrogen Conference

Washington, DC, USA - 4-6 March 2003.

Visit <http://www.hydrogenconference.org/nha/> for information.

SAE World Congress

Detroit, Michigan, USA - 4-6 March 2003.

Visit <http://www.sae.org/congress/index.htm> for information.

Fuel Cell Investment Summit

Uncasville, Connecticut, USA - 17-18 March 2003.

Visit <http://www.fuelcellis.com> for information.

Making Hydrogen Available to the Public

Reykjavik, Iceland - 24-25 April 2003.

Visit <http://newenergy.mirrorz.com> for information.

("Fuel Cell Buses, cont. from pg. 3)

The Berlin, Copenhagen, Lisbon Program is within the framework of the European Union's program for non-nuclear energy – JOULE/THERMIE/ENREGIE. The fuel cell bus involved will be demonstrated throughout Europe, so it will meet Danish, Swedish, German, French, Italian and European regulations and is expected to be in operation in 2003. This project will demonstrate for the first time worldwide the operation of a fuel cell bus powered by liquid hydrogen in regular urban transport.

Berlin's public transportation body, *BVG*, is constructing hydrogen fuel cell buses, with the first model scheduled to hit the streets in 2003. The program, funded by the German Ministry for Economics, will use two double-decker Volvo fuel cell buses on its tourist lines.

Irisbus (a Renault V.I. and Iveco company) plans to begin road-testing a 60-kW hydrogen fuel cell Irisbus in the Northern Italian city of Torino in 2003.

BRIAN WALSH, BREAKTHROUGH TECHNOLOGIES INSTITUTE

WWW RESOURCES

Berlin, Copenhagen, Lisbon Program, <http://www.euweb.de/fuel-cell-bus/index.htm>

California Fuel Cell Partnership, <http://www.cafcp.org>

CUTE Program, <http://www.cute-eu.net/index2.html>

DOE Hydrogen Fuel Cell Bus Evaluation, http://www.ott.doe.gov/otu/field_ops/sunline_eval.html

ECTOS Program, <http://www.ectos.is/ectos.asp>

Fuel Cells 2000's Fuel Cell Bus Chart, <http://www.fuelcells.org/charts.htm#bus>

Georgetown University Fuel Cell Bus Program, <http://fuelcellbus.georgetown.edu>

National Fuel Cell Research Center, <http://www.nfrcr.uci.edu>

Northeast Advanced Vehicle Consortium, <http://www.navc.org/fuelcellbuses.html>

STEP Program, <http://www.dpi.wa.gov.au/fuelcells/>

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